Iowa Farm Science

Volume 2 | Number 12 Article 2

6-1948

Better Protein More Oil in Your Corn

G. F. Sprague
Iowa State College

BETTER PROTEIN MORE OIL in your CORN

by G. F. Sprague

CORN THAT is higher in oil, corn with a better balance of protein — that's something farmers can look forward to. The new improvements will be useful. But they're not as spectacular as they sound. Higher oil content, better proteins can't be seen in the field or in the crib. Farmers are apt to be disappointed if they expect too much.

In many ways the development of high-oil and better-protein corn is like the development of waxy corn. But the improvements will help everybody, not just specialized growers for a limited market.

For the plant breeder, the job is much slower and more complicated than in the case of waxy corn.

Neither one of these improvements will cause much change in the use of corn. But they will make corn more useful both for livestock and for industrial uses. Obviously corn with better protein will have higher feeding value. And within limits higher oil content, too, will make corn better feed. The oil in corn also has value in industrial uses.

Better Protein

A lot has been said and written about high protein corn. We know that we can boost the overall protein content considerably. But the real value of high protein in corn has not been established as yet. The results of such developments may be misleading. They may not increase feed value very much.

Here's why. Proteins are complex organic compounds; they are made up of simpler nutrients called amino acids. Some of these amino acids are essential to normal growth and development.

Others are not. As far as we know, proteins from various food sources differ in the number and the amount of these amino acids that they contain. If all of them are present in the proportions needed for normal growth and development, we call it a balanced protein. If one or more of the essential amino acids are lacking, the protein is deficient. Then we have to make up the deficiency by using some sort of a protein concentrate feed to supplement our ration.

The protein in corn comes from two general areas within the corn kernel. The protein found in the germ area (center portion) is balanced; whereas the endosperm protein (found in outer areas) is not as well balanced. Protein from these outer areas seems to be lacking in both tryptophane and lysine—two of the amino acids that are essential for animal growth.

Balance Counts More

From the research work already done, we know that we can increase the protein percentage in corn. But this may not be desirable for two reasons: First, there is an inverse relation between protein content and yield—as protein percentage goes up, yield declines. Second, the increase in protein percentage is made up mainly of a protein (zein) which has little or no feeding value.

Thus by breeding for a high protein corn, we might increase the percentage of protein in corn considerably over a period of years. But after doing this our corn might have no more value as livestock feed than the regular corn varieties we are feeding to our animals today.

We will gain more by working for a **better balance** of the protein components instead. By improving the protein balance—selecting for more of the useful protein components, less of the components that lack nutritional value—we can actually improve the feeding value of corn without changing the total protein content. This, we believe, is a more useful goal to work for in our plant breeding.

Why More Oil?

Ten to fifteen percent of the Iowa corn crop is sold. A small portion of this is used by "wet-milling" industries. Wet-milling is the process that gives us cornstarch, corn sugar, adhesives and other corn by-products. One of these by-products is corn oil. Another is the protein concentrates that are left over after the starch is taken out. These protein concentrates usually go back to the farm in the form of high protein feeds.

Pound for pound the corn oil that comes out of this extraction process is worth 4 to 5 times as much as the starch. It would seem like a good thing then, if we could develop corn with a higher proportion of oil.

This is possible. In our experimental plots at the Agronomy Farm we have some corn that yields as high as 12 percent oil. The average for ordinary field corn is about 4.5 percent. Given enough time, we can go even higher than 12 percent. We know that we can—but there is a practical limit which will determine the highest oil percentage that is desirable in corn.

It may not be good business to go beyond 8 to 12 percent oil in corn. First of all, if our oil per-

centage got too high the starch manufacturers would have to redesign a lot of their extracting machinery.

And there is another practical limit to the amount of oil in corn. It comes in when you're feeding livestock. We don't have any experimental data on the effect of feeding corn oil to livestock. We do have some on the use of soybean oil, however. And there is every reason to expect that results would be somewhat the same.

Makes Pork "Soft"

Hogs, for instance, develop "soft pork" when we feed them more than 8 percent soybean oil in their ration. A corn with more than 8 percent oil would very likely give us this same problem. Then hogs fed on such corn would take the same discount that hogs fed on peanuts often take because of "soft pork." The quality of the pork would be reduced. It wouldn't pay to feed the high oil corn alone. High oil corn would have to be mixed with other feeds to keep total oil content of the ration down to a certain level—about 8 percent.

As far as we know, the margin is a little higher in the case of cattle. Dairy cattle especially seem to make good use of soybean oil in the production of butterfat. Everything considered, however, it doesn't seem advisable to try to develop the percentage of oil in corn beyond 8 or 12 percent.

High oil corn (8 to 12 percent) is still a few years away from commercial production. But we are far enough along to know that it can be produced on a general scale. In our experimental breeding work, we find that crossing a high yielding corn with a low yielding corn gives offspring that yield somewhere between the two parents.

We already have one line of corn that produces 12 percent oil. If we cross our regular seed stock with these high yielding strains, we may expect to get corn that contains about 8 percent oil. At this level our corn will be more useful in the wet-milling industries. And it will be better feed for livestock too. But beyond this point it does not seem economical to go at the present.

What About Yields?

Another thing we must not forget is a possible effect on yield. We have found no relation between yields and oil content within the range of oil percentage we've worked up to so far. But it is very possible that a cut in over-all yield would set in if we go much higher in oil percentage.

It may take more energy for a plant to produce oil than it does to produce starch. If this is true, any particular hybrid might produce less total yield as soon as its oil content got very high.

The introduction of better protein strains into our present commercial varieties is more difficult than in the case of high oils. In terms of protein content, the offspring of a cross is not so apt to yield an average of the two parents. It tends to be more like the low protein parent instead. This means a lot more breeding and a lot more selection in order to get a better protein hybrid.

Protein Comes Slower

Ordinary corn will usually run from 2.5 to 5.5 percent oil (4.5 percent is average). By careful selection and crossing we can raise the average oil yield of our inbred without much trouble over a few years.

In the case of protein the technique is the same but the results are much slower. In the first place, our means of measuring the more useful protein components is not very accurate. Second, there is such a small quantity of these amino acids in corn that any significant improvement comes very slowly. Average corn runs from about .084 to .124 percent tryptophane (one of the amino acids we are measuring for).

Such improvements as these will be important to farmers and manufacturers in the long run. They will mean a corn that is more valuable for livestock feed and for industrial uses. But you probably won't be able to see the difference in the feedlot. The improvements will not be as spectacular as they sound.

Kernels on the left come from one of our high oil inbreds. Center germ area is larger, also deeper. This area is largely responsible for oil content.

Kernels on the right show a germ area that is much smaller and more shallow. The proportion of oil in this particular inbred runs about 3 percent.